UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte SAM KAO

Appeal No. 2005-1044
Application No. 09/877,366

ON BRIEF

Before GARRIS, PAK, and WARREN, Administrative Patent Judges.
PAK, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 from the examiner's refusal to allow claims 1 through 5, 8 through 12 and 18 through 30. Claims 6 and 7, the other claims pending in the present application, were indicated to be allowable if rewritten in independent form, including all of the limitations of the base claim and any intervening claims.

APPEALED SUBJECT MATTER

According to the appellant (Specification, page 1), the subject matter on appeal is directed to a wafer holder having at least two vortex chambers, which "exploits the non-uniform cooling by the vortices to compensate for other conditions that create temperature non-uniformity."[1] To uniformly cool the entire wafer, for example, the wafer holder is provided with at least two vortex chambers with the first one closest to a vertical rotation axis being designed to cool faster than the second one further from the rotation axis. *Id.* In particular, at least one first vortex chamber closest to the rotation axis is designed to emit more gases or cooler gases than at least one second vortex chamber further from the rotation axis. *Id.* Details of the appealed subject matter are recited in representative claims 1, 8, 10, 18, 21, 24 and 28 which are reproduced below[2]:

1. An article holder comprising:

a first body surrounding a first vortex chamber and having gas inlet and outlet passages terminating at the first vortex chamber; and

a second body surrounding a second vortex chamber and having gas inlet and outlet passages terminating at the first vortex chamber;

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[1] The appellant states that "[t]hose portions of the wafer that are farther from the rotation axis move faster, and hence are cooled more by ambient gas, than the wafer portion close to the rotation axis." See the Specification, page 1. The appellant does not acknowledge that this problem is known in the art or recognized by one of ordinary skill in the art. *Id.*

[2] The appellant asserts that the claims on appeal do not stand or fall together. See the Brief, page 4. Therefore, for purposes of this appeal, we will address the claims separately to the extent they are separately and substantively argued in compliance with the requirements set forth in 37 CFR § 1.192(c)(8)(2003) and 37 CFR § 41.37(c)(1)(vii) (2004).

wherein a combination of the first vortex chamber with all of the gas inlet and outlet passages terminating at the first vortex chamber is not geometrically identical to a combination of the second vortex chamber with all of the gas inlet and outlet passages terminating at the second vortex chamber.

8. An article holder having a surface which is to face an article held in the holder, the article holder comprising a plurality of vortex chucks having outlets in said surface, wherein the surface has a first portion having one or more outlets therein and a second portion having one or more outlets therein, the first and second portions have equal areas, and the first portion has more outlets per unit area than the second portion.

10. An article holder having vortex chucks which are to emit gas vortices to hold an article, wherein all of the vortex chucks which are to emit vortices to hold an article have outlets in a surface which is to be face the article, wherein the surface consists of a first portion and a second portion, wherein the first portion has at least some of its area occupied by at least a part of a vortex chuck outlet, and the second portion also has at least some of its are occupied by at least a part of a vortex chuck outlet, wherein the first portion has a larger percentage of its area occupied by the vortex chuck outlets than the second portion.

18. An apparatus comprising an article holder comprising one or more first vortex chambers to be positioned opposite to a first portion of the article, and one or more second vortex chambers to be positioned opposite to a second portion of the article, for greater cooling of the first portion of the article by the one or more first vortex chambers than of the second portion of the article by the one or more second vortex chambers.

21. An apparatus comprising an article holder comprising one or more first vortex chucks and one or more second vortex chucks, the first and second vortex chucks being to emit gas vortices to hold an article, wherein during operation each of the one or more first vortex chucks emits more gas per unit of time than each of the one or more second vortex chucks.

24. An apparatus comprising an article holder comprising:

one or more first vortex chambers;

one or more first gas sources for supplying gas to the one or more first vortex chambers;

one or more second vortex chambers; and

one or more second gas sources for supplying gas to the one or more second vortex chambers, the first and second gas sources being operable to cause a gas emitted from the one or more first vortex chambers to be colder than a gas emitted from the one or more second vortex chambers.

28. An apparatus comprising an article holder comprising:

one or more first vortex chambers;

one or more first gas sources for supplying gas to the one or more first vortex chambers;

one or more second vortex chambers; and

one or more second gas sources for supplying gas to the one or more second vortex chambers, the first and second gas sources being operable to supply a gas to the first vortex chambers at a greater pressure than to the second chambers.

PRIOR ART REFERENCES

As evidence of obviousness, the examiner relies on the following prior art references:

Siniaguine	6,139,678	Oct. 31, 2000 (Filed Nov. 20, 1997)
Bollinger et al. (Bollinger)	6,467,297 B1	Oct. 22, 2002 (Filed Oct. 12, 2000)
Kunio et al. (Kunio)[3] (Published Japanese Unexamined Patent Application)	57-045233	Mar. 15, 1982

[3] Our reference to Kunio is to its corresponding English translation of record.

The publication incorporated by reference in Siniaguine and relied upon by the Board is:

Tokmulin et al. (Tokmulin)[4] WO 96/21943 Jul. 18, 1996
(Published International Patent Application)

REJECTIONS

The appealed claims stand rejected as follows:

(1) Claims 1 through 5, 8 through 12, 18 through 23 and 28 through 30 under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Kunio and Siniaguine; and

(2) Claims 18 and 24 through 27 under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Bollinger and Siniaguine.

OPINION

We have carefully reviewed the claims, specification and applied prior art, including all of the arguments and evidence advanced by the examiner and the appellant in support of their respective positions. This review has led us to conclude that only the examiner's Section 103 rejections of claims 18, 20 and 24 through 27 are well founded. Accordingly, we affirm the examiner's decision rejecting claims 18, 20 and 24 through 27 under Section 103, but reverse the examiner's decision rejecting claims 1 through 5, 8 through 12, 19, 21

[4] Our reference to Tokmulin is to its corresponding English translation. Copies of Tokmulin and its corresponding English translation are attached to this decision.

through 23 and 28 through 30 under Section 103. Our reasons for these determinations follow.

We turn first to the examiner's rejection of claims 1 through 5, 8 through 12, 18 through 23 and 28 through 30 under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Siniaguine and Kunio. We find that Siniaguine discloses a plasma processing system (110) comprising wafer holders (130) attached to an arm (140A) of a first angle drive (140) which rotates the wafer holders (130) around vertical axis 140X. See column 3, lines 30-65. The wafer holders (130) can be "non-contact wafer holders, such as described, for example, in PCT publication WO 96/21943 ... published Jul. 18, 1996 (inventors I. M. Tokmulin et al.) incorporated herein by reference." See column 3, lines 46-51. We find that Tokmulin referred to above shows wafer holders having at least two vortex chambers (associated with a gas source) positioned opposite to a wafer (article) to be treated, with one of the chambers being closer to a vertical rotational axis than the other. See Figures 1 and 4, together with the abstract. Kunio is cumulative in that it also discloses non-contact wafer holders having at least two vortex chambers (associated with a gas source) positioned opposite to a wafer to be treated. See Figures 1-3 and 5, together with pages 3-7.

It follows that Siniaguine, with or without Kunio, teaches or would have suggested a plasma processing apparatus comprising wafer holders having at least two vortex chambers (associated with a gas source) opposite to a wafer (article) to be treated, with at

least one of the chambers being closer to a vertical rotational axis (center of an angle driver) than the other. According to Siniaguine (abstract), "the article [attached to one of these holders] is asymmetric so that those points on the article that move at a greater linear velocity (due to being farther from the first axis) moves longer distances through the plasma." The appellant also acknowledges at page 1 of the specification that "[t]hose portions of the wafer that are further from the rotation axis move faster, and hence are cooled more by ambient gas..." Implicit in the appellant's admission and Siniaguine's teaching is that a vortex chamber positioned opposite to the faster moving portion of an article is necessarily cooled more than a vortex chamber positioned opposite to the slower moving portion of the article since both the holders having the vortex chambers and articles (wafers) attached thereto are subject to the same rotation.

In view of the foregoing, we determine that Siniaguine, with or without Kunio, would have rendered the subject matter of claims 18 and 20 obvious to one of ordinary skill in the art within the meaning of 35 U.S.C. § 103.

However, the examiner's Section 103 rejection of claims 1 through 5, 8 through 12, 19, 21 through 23 and 28 through 30 as unpatentable over the combined disclosures of Siniaguine and Kunio is on a different footing. As correctly argued by the appellant (e.g., the Brief, page 5), the examiner has not demonstrated that one of ordinary skill in the art would have been led to optimize or adjust the geometry and/or pressure in the claimed manner to emit more gases from one of the vortex chambers in a wafer holder. Nowhere

do Siniaguine and Kunio referred to by the examiner provide any reason or suggestion to emit more gases from one of the vortex chambers in a holder. See the Answer in its entirety. Accordingly, we concur with the appellant that the examiner has not established *prima facie* case of obviousness regarding the subject matter defined by claims 1 through 5, 8 through 12, 19, 21 through 23 and 28 through 30 within the meaning of 35 U.S.C. § 103.

We turn next to claims 18 and 24 through 27 under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Siniaguine and Bollinger. The disclosure of Siniaguine is discussed above. As is apparent from the above discussion, Siniaguine is silent as to emitting more gases and/or cooler gases from one of the vortex chambers.

To remedy this deficiency, the examiner relies on the disclosure of Bollinger. In reference to wafer holders having vortex chambers (vortex chucks) (column 4, lines 43-46), Bollinger teaches at column 3, lines 40-55, that:

> With a substrate holder in accordance with the invention the treatment of a substrate by a hot gas stream can be done with tight control of the substrate temperature and with an increase in the heat transfer from the substrate. A direct fluid cooling of the substrate holder can be done with process temperature feedback to the cooling fluid temperature. Helium can be used as the gas injected into the vortex chucks of the substrate holder to yield significantly higher heat conductivity while enabling a re-circulation of the helium to reduce expenses. **Variations in the local heat removal from the substrate can be obtained by injecting gas into the vortex chucks that has the same temperature as the substrate holder.** A greater heat removal from the substrate is made possible with tight control of temperature by using a liquid, such as water, and use its heat of vaporization for cooling of the substrate. Emphasis added.

Bollinger also teaches (column 6, lines 52-59) that:

> The substrate holder 50 shown in FIG. 5 advantageously provides:
> 1. Uniform processing for temperature dependent wafer treating processes. Temperature of a substrate during processing is a function of the gas flow on the backside 64 of that area of the substrate. **In the regions of the vortex chucks there is a locally higher area of gas flow that increases the cooling of that area of the substrate.** Emphasis added.

Bollinger then goes onto state that the vortex chambers or chucks can be operated by feeding gases tangentially through inlets at various pressures, e.g., in the range of 1 to 10 sccm, into vortex chambers (open holes or annular chambers). See column 5, lines 30-58.

Given the above teachings, we determine that one of ordinary skill in the art would have been led to emit more or less gases and/or much cooler or less cooler gases from appropriate vortex chambers via using appropriately pressurized gas sources[5] and/or appropriate cooling means, motivated by a reasonable expectation of successfully removing varying local heat from different parts of the article (wafer) to obtain temperature uniformity. This is especially true in this situation since one of ordinary skill in the art interested in tightly controlling the temperature of an article (wafer) by removing "[v]ariations in the local heat" therefrom would have readily recognized the temperatures of

[5] We take official notice that it is well known that the amount of gas introduced into any chamber (and the gas emitted therefrom) per a given period is dependent on, *inter alia*, the type of pressure applied to the gas and the dimension and/or the number of gas inlets employed.

different areas of the article, including those areas of the article closer to a vertical rotation axis. *See also In re Ludwig*, 353 F.241, 243-44, 147 USPQ 420, 421 (CCPA 1965).

In view of the foregoing, we determine that the combined disclosures of Siniaguine and Bollinger would have rendered the subject matter of claims 18 and 24 through 27 obvious to one of ordinary skill in the art within the meaning of 35 U.S.C. § 103.

NEW GROUND OF REJECTION

Pursuant 37 CFR § 41.50(b)(2004), we enter the following new ground of rejection against claims 1 through 5, 7 through 12, 19 through 23 and 28 through 30.

Claims 1 through 5, 7 through 12, 19 through 23 and 28 through 30 are rejected under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Siniaguine and Bollinger. We find that Siniaguine discloses a plasma processing system (110) comprising wafer holders (130) attached to an arm (140A) of a first angle drive (140) which rotates the wafer holders (130) around vertical axis 140X. See column 3, lines 30-65. The wafer holders (130) can be "non-contact wafer holders, such as described, for example, in PCT publication WO 96/21943 ... published Jul. 18, 1996 (inventors I. M. Tokmulin et al.) incorporated herein by reference." See column 3, lines 46-51. We find that Tokmulin referred to above shows wafer holders having at least two vortex chambers (associated with a gas source) positioned opposite to a wafer (article) to be treated, with one of the chambers being closer to a vertical rotational axis than the other. See Figures 1 and 4, together with the abstract.

It follows that Siniaguine teaches or would have suggested a plasma processing apparatus having wafer holders having at least two vortex chambers (associated with a gas source) opposite to a wafer (article) to be treated, with at least one of the chambers being closer to a vertical rotational axis (center of an angle driver) than the other. According to Siniaguine (abstract), "the article [attached to one of these holders] is asymmetric so that those points on the article that move at a greater linear velocity (due to being farther from the first axis) moves longer distances through the plasma." The appellant also acknowledges at page 1 of the specification that "[t]hose portions of the wafer that are further from the rotation axis move faster, and hence are cooled more by ambient gas..." Siniaguine is silent as to emitting more gases and/or cooler gases from one of the vortex chambers closer to the vertical rotation axis via increasing the number or dimension of gas inlets and/or increasing the gas pressure.

However, in reference to wafer holders having vortex chambers (chucks) (column 4, lines 43-46), Bollinger teaches at column 3, lines 40-55, that:

> With a substrate holder in accordance with the invention the treatment of a substrate by a hot gas stream can be done with tight control of the substrate temperature and with an increase in the heat transfer from the substrate. A direct fluid cooling of the substrate holder can be done with process temperature feedback to the cooling fluid temperature. Helium can be used as the gas injected into the vortex chucks of the substrate holder to yield significantly higher heat conductivity while enabling a re-circulation of the helium to reduce expenses. Variations in the local heat removal from the substrate can be obtained by injecting gas into the vortex chucks that has the same temperature as the substrate holder. A greater heat removal from the substrate is made possible with the tight control of temperature by

> using a liquid, such as water, and use its heat of vaporization for cooling of the substrate.

Bollinger also teaches (column 6, lines 54-59) that:

> The substrate holder 50 shown if Fig. 5 advantageously provides: 1. Uniform processing for temperature dependent wafer treating processes. Temperature of a substrate during processing is a function of the gas flow on the backside 64 of that area of the substrate. In the regions of the vortex chucks there is a locally higher area of gas flow that increases the cooling of that area of the substrate.

Bollinger then goes onto state that the vortex chambers or chucks can be operated by feeding gases tangentially through inlets at various pressures, e.g., in the range of 1 to 10 sccm, into the vortex chambers (open holes or annular chambers). See column 5, lines 30-58. It is also well known that the amount of gas introduced into any chamber (and the gases emitted therefrom) per a given period is dependent on, *inter alia*, the type of pressure applied to the gas and the dimension and/or the number of gas inlets employed.

Under the circumstances recounted above, we determine that one of ordinary skill in the art would have been led to emit more gases and/or much cooler gases from appropriate vortex chambers, i.e., those closest to the vertical rotation axis, via using appropriately pressurized gas sources, an appropriate number of gas inlets, appropriately dimensioned gas inlets and/or appropriate cooling means, motivated by a reasonable expectation of successfully removing varying local heat from the article (wafer) to obtain temperature uniformity. This is especially true in this situation since one of ordinary skill in the art interested in tightly controlling the temperature of an article (wafer) by removing

"[v]ariations in the local heat" therefrom would have readily recognized the temperatures of different areas of the article, including those areas of the articles closer to the vertical rotation axis. *See also In re Ludwig*, 353 F.241, 243-44, 147 USPQ 420, 421 (CCPA 1965).

In view of the foregoing, we determine that the combined disclosures of Siniaguine and Bollinger would have rendered the claimed subject matter obvious to one of ordinary skill in the art within the meaning of 35 U.S.C. § 103.

CONCLUSION

In summary:

1) The Section 103 rejection of claims 18 and 20 as unpatentable over the combined disclosures of Siniaguine and Kunio is affirmed;

(2) The Section 103 rejection of claims 1 through 5, 8 through 12, 19, 21, 21 through 23 and 28 through 30 as unpatentable over the combined disclosures of Siniaguine and Kunio is reversed;

(3) The Section 103 rejection of claims 18 and 24 through 27 as unpatentable over the combined disclosures of Siniaguine and Bollinger is affirmed; and

(4) The Section 103 rejection of claims 1 through 5, 7 through 12, 19 through 23 and 28 through 30 as unpatentable over the combined disclosures of Siniaguine and Bollinger is newly entered by the Board pursuant to the provisions of 37 CFR § 41.50(b).

Regarding the affirmed rejection(s), 37 CFR § 41.52(a)(1) provides "[a]ppellant may file a single request for rehearing within two months from the date of the original decision of the Board."

In addition to affirming the examiner's rejection(s) of one or more claims, this decision contains a new ground of rejection pursuant to 37 CFR § 41.50(b) (effective September 13, 2004, 69 Fed. Reg. 49960 (August 12, 2004), 1286 Off. Gaz. Pat. Office 21 (September 7, 2004)). 37 CFR § 41.50(b) provides "[a] new ground of rejection pursuant to this paragraph shall not be considered final for judicial review."

37 CFR § 41.50(b) also provides that the appellant, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

> (1) *Reopen prosecution.* Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceeding will be remanded to the examiner. . . .
>
> (2) *Request rehearing.* Request that the proceeding be reheard under § 41.52 by the Board upon the same record. . . .

Should the appellant elect to prosecute further before the examiner pursuant to 37 CFR § 41.50(b)(1), in order to preserve the right to seek review under 35 U.S.C. §§ 141 or 145 with respect to the affirmed rejection, the effective date of the affirmance is deferred until

conclusion of the prosecution before the examiner unless, as a mere incident to the limited prosecution, the affirmed rejection is overcome.

If the appellant elects prosecution before the examiner and this does not result in allowance of the application, abandonment or a second appeal, this case should be returned to the Board of Patent Appeals and Interferences for final action on the affirmed rejection, including any timely request for rehearing thereof.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART/§ 41.50(b)

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